ERCB Energy Resources Conservation Board
Calgary Office 640–5 Avenue SW Calgary, Alberta. Canada T2P 3G4 Tel 403-297-8311 Fax 403-297-7336 www.ercb.ca

Directive 039

Original edition July 10, 2006
Revised edition July 7, 2008

Revised Program to Reduce Benzene Emissions from Glycol Dehydrators

The Energy Resources Conservation Board (ERCB) and Alberta Environment have approved this directive on July 7, 2008.

B. T. McManus, Q.C.
Acting Chairman
Energy Resources Conservation Board

Jim Ellis
Deputy Minister
Alberta Environment

In this edition of *Directive 039*, Attachment 3 has been deleted, and compliance information has been added in the Compliance and Enforcement section on page 3. Attachment 4 has been renumbered as Attachment 3. No requirements have changed.

This directive sets out new requirements for the reduction of benzene emissions from glycol dehydrators and replaces the joint Alberta Energy and Utilities Board (EUB) (precursor to the ERCB) and Alberta Environment (AENV) *Informational Letter (IL) 2001-07: Revised Program to Reduce Benzene Emissions from Glycol Dehydrators*. These requirements will also be incorporated into ERCB *Directive 060: Upstream Petroleum Industry Flaring, Incineration, and Venting*, (formerly *Guide 60: Upstream Petroleum Industry Flaring Guide)*.

With the issuance of this directive, the ERCB and AENV have established mandatory requirements to ensure continued reductions of benzene emissions to reduce potential impact on the public.

Licensees must comply with the following new requirements effective January 1, 2007:

1) When evaluating dehydration requirements in order to achieve the lowest possible benzene emission levels, licensees must use the Decision Tree Process in Appendix A of the Canadian Association of Petroleum Producers (CAPP) document *Best Management Practices for Control of Benzene Emissions from Glycol Dehydrators,* June 2006 (*Benzene Control BMP*) and retain appropriate analysis documentation for review by regulatory agencies. Licensees must follow the public consultation process outlined in the Benzene Control BMP.

2) Licensees must ensure that all their dehydrators meet the following benzene emission limits.

Date Dehydrator Installed or Existing Dehydrator Relocated	Benzene Emission Limits
Prior to January 1, 1999	
• Greater than 750 m to permanent resident or public facility	5 tonnes/yr
• Less than 750 m to permanent resident or public facility	3 tonnes/yr
January 1, 1999, to January 1, 2007	3 tonnes/yr
After January 1, 2007	1 tonne/yr

Specific Benzene Emission Limits

i) If more than one dehydrator is located at a facility or lease site, the cumulative benzene emissions for all dehydrators must not exceed the limit of the oldest dehydrator on site. Modifications may be required to existing unit(s) to meet the site limit.

ii) Any new or relocated dehydrators added to an existing site with dehydrator(s) must operate at a maximum benzene emission limit of 1 tonne/yr or less. The cumulative benzene emissions must not exceed the limit of the oldest dehydrator on site.

iii) For dehydrators that are only in operation for a portion of the year, the daily emission rate must not exceed the above annual benzene emission limits divided by 365. (For example, for a dehydrator with an annual benzene emission limit of 3 tonnes that only operates for six months of the year, the maximum annual emission limit would be 1.5 tonnes or a maximum daily emission rate of 8.2 kg/day.) See Section 2.3 of the *Benzene Control BMP* for details on calculating and reporting of emissions from dehydrators that only operate a portion of the year.

3) Licensees must complete a Dehydrator Engineering and Operations Sheet (DEOS) (see Attachment 1) to determine the benzene emissions from each dehydrator. This sheet summarizes optimum operating conditions to minimize benzene emissions and must be posted at the dehydrator for use by the operations staff and inspection by the ERCB. The DEOS must be revised every 12 months, upon relocation, or upon a change in status (resume operation, shut-in, bypassed) of the dehydrator.

4) Licensees must complete and submit an annual Dehydrator Benzene Inventory List (see typical inventory list in Attachment 2), listing all the licensees' dehydrators, as set out in the June 2006 CAPP *Benzene Control BMP* by July 1 each year. Copies of the annual Dehydrator Benzene Inventory List form are available from CAPP at www.capp.ca. This information must be submitted to the ERCB through the Multi-Stakeholder Benzene Technical Advisory Team (Benzene TAT) (by mail to Attention: Manager of Alberta Operations, CAPP, Suite 2100, 350 - 7 Avenue S.W., Calgary, Alberta T2P 3N9; or by e-mail to benzene.tat@capp.ca).

The latest version of the *Benzene Control BMP* is available from CAPP at http://www.capp.ca/raw.asp?x=1&dt=PDF&dn=105760. This document describes procedures for selecting appropriate dehydration, calculating emissions, maintaining records, and reporting reductions of benzene emissions from glycol dehydrators. Questions regarding the document and the processes it outlines may be directed to CAPP at (403) 267-1100 or by e-mail at benzene.tat@capp.ca.

Compliance and Enforcement

These requirements will be subject to compliance review by the ERCB. Regulatory requirements are those rules that industry has an obligation to meet and against which the ERCB may take enforcement action in cases of noncompliance. For the purpose of *Directive 039*, noncompliance events are listed in the matrix Risk Assessed Noncompliances on the ERCB Web site www.ercb.ca under Industry Zone : Compliance and Enforcement : Risk Assessed Noncompliance. Enforcement for noncompliance will be in accordance with *Directive 019: ERCB Compliance Assurance—Enforcement.*

AENV may also review for compliance, and failure to comply may result in the issuance of Environmental Protection Orders (EPO), as outlined in the Alberta *Environmental Protection and Enhancement Act.*

Background

Benzene is classified as a toxic substance under the *Canadian Environmental Protection Act* and as a Group 1 carcinogen by the International Agency for Research on Cancer. As a non-threshold carcinogen, there is considered to be some health risk at any level of exposure. As a result, benzene emissions must be managed to achieve the lowest levels practicable to minimize human exposure. A Benzene Workplace Health and Safety Sheet (Attachment 3) was prepared by the Benzene TAT to promote awareness of benzene hazards and methods to minimize exposure for operations staff.

As described in *IL 2001-07*, the oil and gas industry has had a Benzene Reduction Program in place since 1997. The program is managed by the Benzene TAT, which includes representatives from Health Canada, CAPP, Environment Canada, ERCB, AENV, B.C. Environment, and Saskatchewan Environment. A recent status report shows that only 26 per cent of new dehydrator installations have used the Decision Tree Process outlined in the November 2000 CAPP *BMP for Control of Benzene Emissions* to optimize dehydrator performance to reduce benzene emissions to as low a level as possible.

While the Benzene TAT is encouraged by the benzene emission reductions achieved from glycol dehydrators, it has determined that new requirements are needed to maintain current reductions achieved, strive for continuous improvement in controlling emissions, select appropriate dehydration, improve reporting of emissions, and operate dehydrators more efficiently. The new requirements in this directive should result in dehydrators being operated at optimum conditions to ensure that emissions and potential health effects from benzene are minimized.

Contact

Any comments or questions with respect to this directive should be directed to the ERCB's Environment Group at 403-297-8330 or by e-mail at enviro.services@ercb.ca or to the AENV Environmental Policy Branch at 780-427–6869 or by e-mail at randy.dobko@gov.ab.ca.

(This sheet must be revised annually, or upon dehydrator relocation or change in status, and posted at the dehy.)

Technical Contact: Print Name/Phone #/email: _____

Revision Date (dd-mm-yyyy): _____ **Facility or Site Name:** _____

Licensee Name: _____ **Operator Name:** _____

Gov't Licence No: _____ **Location, DLS:** __-__-__-__W_ **(or NTS:** _____ **)**

Installation Type: ☐ Well ☐ Compressor ☐ Battery ☐ Plant ☐ Cavern ☐ Other **DEHY Type:** ☐ TEG ☐ DEG ☐ EG

Date Dehy installed/relocated? (dd-mm-yyyy): _____ **Current Dehy Status:** ☐ Producing ☐ Shut-In ☐ Bypassed ☐ Other: _____ **Date Dehy Status Changed? (dd-mm-yyyy):** _____

Typical number of operating days per year: _____ **Number of dehys on site:** _____

Distance to Closest Resident (if < 750 metres): _____ **Normal Gas Flow Rate to Dehy:** ($e^3 m^3/d$): _____

Benzene Content in Gas to Dehy (mole %):_____ (If zero, Dehy operations sheet must still be posted)

Feed gas benzene determi n method: ☐ Analysis Date of analysis (dd-mm-yyyy): _____

☐ Other (describe): _____

Glycol Pump Make/Model# _____ **Normal Pump Speed:**_____ RPM or SPM

Plunger diameter/stroke length: _____ inches, or _____ mm

Normal Glycol Circulation: _____USgpm **Normal Absorber Temp:** _____°C **Normal Absorber Press:** _____kPag

Emission Calculation Method: ☐ GRI GLYCalc™ Version #:__ ☐ HYSYS™ ☐ ProSim™ ☐ Total Capture ☐ Rich/Lean Glycol ☐ Other—Describe:_____

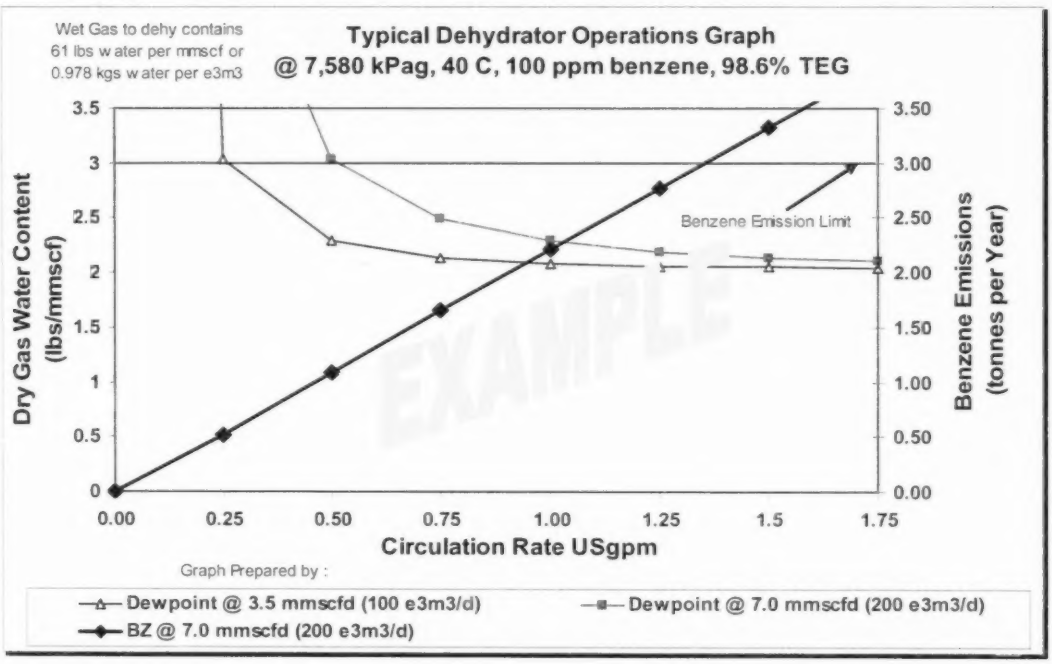
Benzene Emission Controls: ☐ No ☐ Yes Describe (condenser, tank, incinerator, flare, other):

_____

Dehy decision tree analysis (DTA) completed?: ☐ No ☐ Yes **(mandatory for all new or relocated dehys)**

When operating, average benzene emissions (in tonnes/yr)* Before Controls: _____ After Controls: _____

***Note:** **In accordance with EUB Directive 039, this dehydrator must be operated below _____ tonnes/yr benzene emissions. If multiple dehys exist on this site, the aggregate benzene emissions must be less than _____ tonnes/yr, which is the maximum per year allowed for the oldest dehy on site.**


Wet Gas to dehy contains
61 lbs water per mmscf or
0.978 kgs water per e3m3
Typical Dehydrator Operations Graph
@ 7,580 kPag, 40 C, 100 ppm benzene, 98.6% TEG
Dry Gas Water Content (lbs/mmscf)
Benzene Emissions (tonnes per Year)
Benzene Emission Limit
EXAMPLE
Circulation Rate USgpm
Graph Prepared by :
Dewpoint @ 3.5 mmscfd (100 e3m3/d)
Dewpoint @ 7.0 mmscfd (200 e3m3/d)
BZ @ 7.0 mmscfd (200 e3m3/d)

Attachment 2 **Canadian Oil and Gas Industry - Annual Dehydrator Benzene Inventory List For:** **2006 (yyyy)** Company Net Gas Production: $10^3 m^3$ /day

Instructions: This form must be completed and submitted annually by July 1st for the previous year of operations. Upon completion, submit this form to the Benzene Technical Advisory Team by email to benzene.tat@capp.ca Attention: Manager of Alberta Operations, CAPP

Company Data Revision Date: July 1, 2007 **Date Submitted to CAPP:** July 1, 2007

DEOS Completed	Multiple Dehys on Site?	Licensee	Unique Identifier								Dehydrator Use (Installation Type)			Production Status	Benzene Concentration (Gas to Dehy)	Number of Operating Days per year	Benzene Emissions Rate While Operating	Annual Benzene Emissions for dehydrator	
		Operating Company Name	Field Name	BC Centizone	Complete LSD 01-01-020-25W4	LSD	Sect	Twn	Rge	Mer	Installation Type	Glycol Type	Operating Status	Normal gas flowrate to dehy				Emissions Prior to Control	Emissions After Control
Yes No / Specify: - Shut In - Separator Ops - Sold	Yes / No										Compressor Battery Wellsite Gas Plant Storage Cavern Other	TEG DEG EG Other	Operating Shut-in De-commissioned By-passed Operating as a separator Other	$10^3 m^3$ /day or shut-in or by-passed, or operating as separator or other	Mole % for each dehy	days	kilograms/day	tonnes Number of Operating Days x Emissions Rate	
			Field Name	BC Centizone	Complete LSD	LSD	Sect	Twn	Rge	Mer									
Example Data:																			
Yes	Yes	ABC Resources Inc.	Sample Location Field		01-01-020-25W4	1	1	20	25	4	Compressor	TEG	Operating	200	0.015%	300	2.00	3.50	0.60
Yes	Yes	ABC Resources Inc.	Sample Location Field		01-01-020-25W4	1	1	20	25	4	Compressor	TEG	Operating	200	0.018%	200	9.50	6.00	1.90

*Note: Copies of the Annual Dehydrator Benzene Inventory List Forms are available from CAPP at www.capp.ca

Annual Dehydrator Benzene Inventory List (continued)

	Cumulative Annual Benzene Emissions		Emissions Calculation Method	Emission Control Method	Installation Details											Comments
Above Dehy Limit?	For all dehydrators on site	Above Site Limit?			Installed / Modified after Jan. 1, 2001?	Date of Installation/ Relocation, if known	Decision Tree Analysis Completed? (EUB Directive 039)	Number of dehys on site	For This Dehy Allowed Annual Benzene Emissions	For This Dehy Allowed Daily Benzene Emissions	Oldest Dehy Allowed Annual Benzene Emissions	Oldest Dehy Allowed Daily Benzene Emissions	Distance to Closest Residence	Were residents contacted?	Date Site Record Changed	Additional Comments
Yes / No	tonnes Add up the emissions from all previous rows per site. **Leave single dehys blank.**	Yes / No	GRI-GLYCalc™ HYSYS™ Prosim™ Total Capture Rich/Lean Glycol Other (describe)	No Control / Emit to Atmosphere Aboveground/ Underground Tank Flare / Incinerator Process Optimization Commercial Condenser Other (describe)	Yes / No	yyyy-mm-dd	Required for all New/ Relocated Dehydrators		tonnes/yr Show dehydrator limit only	kilograms/day Show dehydrator limit only	tonnes/yr Show dehy limit of oldest dehy on site if more than one dehy	kilograms/day Show dehy limit of oldest dehy on site if more than one dehy	m Flag red if <750 m a	Yes / No c	yyyy-mm-dd	
No			GRI-GLYCalc™	No Control	Yes	2/1/2001	Yes	2	3.0	8.22	5.0	13.70	1,120	No	10/12/2005	New unit
No	2.50	No	GRI-GLYCalc™	No Control	No	2/1/1998	Yes	2	5.0	13.70	5.0	13.70	1,120	No	10/12/2005	Old unit

*Note: Copies of the Annual Dehydrator Benzene Inventory List Forms are available from CAPP at www.capp.ca

Sample

Attachment 3 Benzene—Workplace Health and Safety

What is benzene?
Benzene, a colourless, flammable liquid with a sweet odour, is classified as a toxic substance under the *Canadian Environmental Protection Act*. As a non-threshold carcinogen, it is considered to be of some health risk at any level of exposure. It is also classified as a Group 1 carcinogen by the International Agency for Research on Cancer (IARC). It is to be managed by reducing human exposure to the extent possible and practicable.

Where is benzene found in the workplace?
Crude oil and natural gas condensate contain benzene. The concentration varies depending on the geology and location of the well site. Benzene and other hydrocarbons may be released from stacks, flares, glycol dehydrators, hydrocarbon storage facilities, and other operations that involve crude oil or condensate. Occupational exposure to benzene in the upstream oil and gas industry occurs mainly through the use of glycol dehydrators as benzene is removed from the gas stream during dehydration.

How can workers become exposed to benzene?
Workers may become exposed by inhalation or by direct contact with the skin. This may occur when changing filters and pumps and when handling rich glycol at dehydrators. Although readily absorbed after inhalation, benzene is not easily absorbed through skin contact. The absorption of benzene vapour through the skin is unlikely to be significant at concentrations below 25 ppm.

What are the health risks of benzene exposure?
Short-Term Acute Exposure
Acute exposures (greater than 3200 $\mu g/m^3$ or 1000 ppb over an 8-hour period) are unlikely during routine operations and worker activities. Limited studies suggest that acute exposure to benzene may depress the central nervous system. Common symptoms at 50 to 150 ppm are drowsiness, dizziness, headache, nausea, vomiting, sleepiness, fatigue, nose and throat irritation, slurred speech, loss of balance, and disorientation. Exposure above 20 000 ppm for 5 to 10 minutes can cause death.

Long-Term Chronic Exposure
Chronic exposure may result in a range of health effects, depending on the dose and frequency of exposure. Health effects of prolonged exposure relate mainly to the skin and blood. Prolonged and repeated contact with benzene can cause redness, drying, and cracking of the skin. Prolonged exposure above workplace limits may suppress the production of red blood cells, white blood cells, and clotting cells by damaging bone marrow. Benzene may also increase the incidence of a specific type of leukemia (acute myelogenous leukemia) and other forms of leukemia and lymphomas.

Exposure to benzene along with other substances may enhance health effects. Exposure to benzene and ethanol can increase the effects on the blood system. Exposure to toluene and benzene can reduce the body's ability to remove benzene, as toluene slows the rate of clearance of benzene by competing for metabolic pathways.

How can you avoid exposure to benzene?
Engineering Controls
- Optimize glycol circulation.
- Implement alternatives for hydrate control and dehydration, such as using a flash tank separator, a line heater, or solid desiccant or molecular sieve plants.
- Ensure that equipment and barriers for preventing exposure are working and maintained according to specifications.

Administrative controls

- Verify that safe work practices are formalized, reviewed, and updated.
- Ensure that employees are properly trained in safe work practices.
- Monitor air to ensure that the benzene concentration does not exceed the occupational exposure limit.

Personal protective equipment

- Use close-fitting goggles or a National Institute for Occupational Safety and Health (NIOSH)-approved supplied-air respirator (SAR) with a full face mask that includes an end-of-use indicator.
- Wear, wash, and maintain chemical-resistant clothing (gloves, coveralls, boots) appropriate for conditions of use.